# Optimization and Extraction of Natural Long Bamboo Fibers

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***Abstract*: The modern dynamic world can't imagine its development without bringing the concept of advancement in composite material. Natural fibers reinforced polymer composite has a huge affinity to replace the composite made up of synthetic fibers. The purpose of using the Bamboo as the material for this study is due to the advantages it has over other materials like high specific stiffness, high strength, low weight, low cost, biodegradability, non-abrasive nature and sound absorption. Even today extraction of good quality fibers from the bamboo culm is still a challenge; this work has been carried out to explore the possibility of obtaining the good quality of long fibers from the bamboo which can be used as reinforcement in composite material.We used Mechanical andChemical processes to extract the long fibers from bamboo.The recently developed method for extracting long bamboo fibers opens the possibility to exploitthis new material as reinforcement in composite materials for high end users.**

***Keywords:* Natural fibers, Synthetic fibers, Bamboo Fibers, Glass fibers.**

## I. INTRODUCTION

Natural fibers are becoming a real alternative as reinforcement for composite materials thanks to their green nature, low density, and in some case better specific mechanical properties than glass fibers [1].Bamboo fibers are focused as one of the substitution for natural plant fibers having many advantages such as low cost, low density, ecologically friendly, sustainability and biodegradability [2]. Hence Bamboo has been used as the natural fibers in this study. Bamboos are the largest member of the grass family *Poaceae.* A long fleshy plant but the appearance is never like grass. It is soft towards the center and hard towards its periphery. Therefore, bamboo fibers are often called 'natural glass fiber'. There are 87 genera with about 1500 species of bamboo distributed worldwide [3]. Bamboo is one of the fastest renewable plants with maturity cycle of 3-4 years of age are suitable for any utilization. Bamboo reach their full height of 15-30 (35) m within a period of 2-4 months [4] by diurnal growth rates of about 20 cm up to 100 cm. Taking also in to account their diameter of 5- 15 (30) cm.Bamboo has excellent mechanical properties in comparison with its weight due to longitudinally aligned fibers [5].In general the culm consists of about 50% parenchyma cells, 40 % fibers, and 10 % vascular bundles (Vessels, sieve tubes with companion cells).The fibers characterized by their slender form, long and often forked at the ends. They present around the vascular bundles as sheaths and as isolated strands. They amount to about 40 % of the mass and to 60-70 % of the weight of the culm. The vascular bundle consists of the two metaxylem vessels, fibers and the metaphloem of sieve tubes with companion cells. The main chemical constituents of the culm tissue are cellulose (73.83%), hemicellulose (12.49%), and lignin (10.16%).The density of bamboo varies from about 0.4 to 0.9 g/cm$^3$ depending on the anatomicalstructure such as the quantity and distribution of fibers around the vascular bundles. Accordingly, density increases from the inner lawyer to the outer part of the culm and along the culm from the bottom to the top. The mechanical strength of bamboo generally increases with the thickening of the fiber walls until maturity is reached after approximately 3 years, but also later on [6]. The present study focuses to identify & standardize the process to extract the bamboo fibers having length equal to the internodal length of bamboo. These extracted bamboo fibers may be used as reinforcement in conventional polymeric material.

## II. MATERIALS AND METHODS

### *2.1 Materials*

The Bamboo Species used in this study is Bambusa bamboo of 3 years age, which was cut into 10 pieces each of length 4 ft.as shown in fig 1.0 and fig 1.1.

Fig 1.0 Bamboo Stock

Fig 1.1Bambusa Bamboo

Initially various equipment's were used for processing of the culm like knot Removal Machine,Splitting machine,Planning Machine, Cross cutting machine and Sliver machine to make strips and chemicals like NAOHand HCL solutionwas used for retting and cleaning.

*2.2 Methods*

*2.2.1 Extraction of Bamboo Fiber*

For the current work, bamboo fibers have been extracted mechanically and as well as chemically.Initially the culm of 4 feet was selected and the knots were removed using the Knot cleaning machine fig2.0. The cylindrical portion of culm was split into 8 pieces using the splitting machine fig 3.0 and then using the planning machine fig 4.0 and fig 4.1 the epidermal and the endodermal layer was removed. Then using the Sliver machine the pieces were made into strips of 3mm thick and standardwidth. Later the strips were cut into intermodal length using the cross cutting machine which were used for the extraction processes.

Fig 2.0 Knot Removal Machine

Fig 3.0 Splitting Machine

Fig 4.0 Removal of Epidermal Layer

Fig 4.1 Removal of Endodermal Layer

*2.2.2 Mechanical Fiber Extraction Process:*

*Water Retting:* The strips were soaked in a tray filled with water for 3 days fig 5.0. Later these wetted srips were beaten, scraped with sharp edged knife and then combed to get long fibers fig 5.1

Fig 5.0 Water Retting

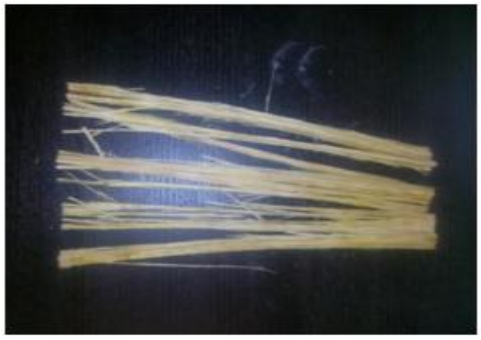

Fig 5.1 Extracted Long Fibers

**Crushing:** In this process the raw bamboo was cut into small pieces by a roller crusher and was put into the dehydrator to be boiled at 90 degress centigrade for over a period of 10 hrs to remove the fat and then dried in a rotary drier. Later these dried pieces were extracted into coarse long fiber by a pin roller.

*2.2.3 Chemical Fiber Extraction Process:*

*Alkali Retting:*

In this process we used NAOH solution for soaking the bamboo strips for duration of 3 hours at 5% mass per volume fig 6.0. And later these strips were taken out of the solution and hammered to get long fiber fig 6.1.Then these fiber bundles were washed with HCL to neutralize the chemicals present on the fibers.

Fig 6.0 Alkali RettingFig

6.1 Fine Long Fiber bundles

## III. RESULTS AND DISCUSSIONS

In the mechanical process of water retting method it was observed that during the scrapping of the fiber surface the long fibers were damaged and had a strong effect on the quality. And also in crushing method it was observed that the bamboo longfibers obtained were split and had become powdered after over mechanical processing. Hence the water retting and crushing method of extracting the long fibers was not considered as the suitable method for the extraction and was ruled out. But where as in chemical process of alkali retting it was observed that the long fibers that were extracted were of good quality without any damage hence this process of extracting the long fibers was considered to be the best method of extraction.

## IV. CONCLUSIONS

Comparing the long fibers that were obtained from the mechanical and chemical process, we found that the long fibers obtained from chemical process were superior to the long fibers obtained from mechanical process. To comprehend these natural long fibers of bamboo could be used as the reinforcement material for composites.

## ACKNOWLEDGEMENTS

The Author of this paper would like to express their gratitude and sincere appreciation to the Director, Indian Plywood Industries Research and Training Institute (IPIRTI), Bangalore, India which is an Autonomous body of the Ministry of Environment and Forests Govt. of India, for providing the facility to carry out the work without which this work would not have been possible.

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